REMARKS

Claims 1-48 are pending in the application. Claims 43-48 are allowed.

As a preliminary matter, Applicant wishes to thank the Examiner for confirming allowable subject matter in claims 43-48.

Claims 1-7 and 11-21 stand rejected under §103(a) as being unpatentable over Loop (U.S. Patent No. 5,602,979) in view of Krishnamurthy (U.S. Patent No. 6,256,038). As to claim 1, the Examiner cites to Loop for its teachings related to forming meshes comprising a base mesh and one or more higher level meshes, and to Krishnamurthy for its teachings related to hybrid mesh representations. However, both Loop and Krishnamurthy fail to disclose a requirement of claim 1, namely, forming a hybrid mesh from a regular base mesh through regular refinement operations in combination with *at least one irregular refinement operation*. Moreover, Krishnamurthy teaches away from forming hybrid meshes using irregular refinement operations.

The present application at page 2 distinguishes between "regular," "semi-regular," and "irregular" meshes. Page 9 defines an "irregular operation" as one which does not necessarily maintain vertex valence restrictions, and a "hybrid" mesh as a mesh formed from a regular base mesh by at least one regular refinement step and at least one "irregular operation." As explained on pages 2-3, compared to regular and semi-regular meshes, a hybrid mesh is able to represent object features without requiring polygons with bad aspect ratios.

Loop fails to disclose the requirement for generating a hybrid mesh through an irregular refinement operation. Rather, Loop merely discloses a method for generating the semi-regular mesh distinguished over in the background section of the subject application. That is, the Loop method starts with an irregular mesh as an *input* to the algorithm, but the algorithm itself does *not* perform an irregular operation. *See* Loop, Fig.2; col. 6, line 6; col. 8 lines 42-49; col.9 lines 11-15. The Loop algorithm forms higher level meshes M^1 and M^2 by means of regular operations only. These regular operations are a "general refinement step" and a "constrained refinement step," respectively. Loop, Fig.2; col.9 lines 1-10.

The general refinement step of Loop is a regular operation because it produces a regular mesh by converting every *n*th order vertex in M^0 into *n* vertices in M^1, where each vertex in M^1 is of restricted order. Loop, col.9 lines 16-33. This can be seen graphically in Fig.6 of Loop.

There, M^0, which comprises the dark lines only, contains two interior vertices. The leftmost of these is a third order vertex, and the rightmost is a fifth order vertex. After applying the general refinement step, mesh M^1 is produced, which comprises the lighter solid lines of Fig.6. The third order vertex of M^0 now lies in M^1 at the centroid of a triangular face having a 4^{th} order vertex at each of its three points. The fifth order vertex now lies in M^1 at the centroid of a pentagonal face having a 4^{th} order vertex at each of its five points. Thus, the general refinement step has restricted every interior vertex of M^1 to 4^{th} order, making M^1 a regular mesh.

The constrained refinement step of Loop is also a regular operation because it also produces a regular mesh, where each interior vertex is restricted to 4^{th} order. Loop, Fig.7; col.10 lines 54-57. This is clearly illustrated in Fig.7, which shows a mesh M^2 that appears as a further refined version of M^1. Note that each interior vertex of M^2 is also constrained to 4^{th} order. Indeed, the vertices and polygons of M^2 correspond directly to the vertices and polygons of M^1. Thus, the constrained refinement step results in the formation of another regular mesh. Loop, Fig.7; col.11 lines 13-17.

Krishnamurthy also fails to disclose the requirement for generating a hybrid mesh through an irregular refinement operation. The Examiner cites to Krishnamurthy for its teachings regarding hybrid representations. However, the term "hybrid" as defined in Krishnamurthy has a completely different meaning than the definition of "hybrid" as used in the present application. In Krishnamurthy, a "hybrid" representation is "a combination of a tensor product B-spline surface and a displacement map." Krishnamurthy, col. 11 lines 5-8; col. 44 lines 47-48. First, note that a B-spline surface is a type of smooth surface representation, and is therefore *not* a form of mesh representation, neither regular nor irregular. Krishnamurthy, col. 1 lines 19-37; col. 2 lines 1-2. Second, note that a displacement map is defined as a function that perturbs the position of points on a smooth surface. Krishnamurthy, col. 45 lines 63-65.

Generally, Krishnamurthy teaches refining a smooth surface representation (as opposed to a mesh representation) by displacing points on a B-spline surface using scalar or vector functions executed by means of commercially available displacement map programs. Krishnamurthy, col. 45 line 14 through col. 46 line 4. Displacing points on smooth surface representations is not performing irregular refinement operations because point displacement does not produce a mesh representation, let alone an *irregular* mesh representation. Thus, the methods of Krishnamurthy

are not applicable to surface representations comprising meshes. In sum, a "hybrid" representation according to Krishnamurthy bears no relation to a "hybrid" as defined in the present application.

In view of the above, Applicant respectfully submits that the requirement of a hybrid mesh produced through an irregular refinement operation would not have been obvious from the combination of Krishnamurthy and Loop. As noted above, the teachings of Loop are directed to forming a semi-regular mesh, and Krishnamurthy teaches refining smooth surfaces by displacing points on the surface. Neither teaches performing irregular operations on a mesh. Therefore, in any combination Loop and Krishnamurthy that might result, the requirement of a hybrid mesh produced through at least one irregular refinement operation would not be met.

Furthermore, Krishnamurthy specifically teaches away from using irregular meshes as a means of representing object surfaces. Throughout the Krishnamurthy disclosure, surface representations in the form of irregular meshes are characterized as disadvantageous. *See, e.g.* Krishnamurthy, col. 1 lines 38-40; col. 1 lines 64-67; col. 12 lines 57-58; col. 13 lines 26-29; col. 16 lines 6-9; and col. 25 lines 39-43. Krishnamurthy teaches the conversion of an existing polygonal mesh into a smooth surface representation (*see* Abstract, final sentence), but otherwise discourages using mesh representations, and in any case offers no suggestion for combining an irregular mesh operation with the teachings of Loop.

The requirement of hybrid meshes formed through at least one irregular refinement operation represents a significant advancement over regular and semi-regular meshes. Unlike regular and semi-regular meshes, such hybrid meshes are able to represent detailed features of an object in higher level meshes even though those features are not represented in the base mesh. Application at p.2. The result is that stretched polygons with bad aspect ratios are avoided in the hybrid mesh representation. Application at p.3. The hybrid mesh representation is thus much more flexible and computationally efficient compared to regular and semi-regular mesh representations.

In view of the foregoing discussion, Applicant respectfully submits that the rejection of claim 1 should be withdrawn. It therefore follows that the Examiner's rejections of claims 2-7 and 11-14, each of which is dependent on claim 1, should also be withdrawn.

As to claims 15-16, Applicant notes that claim 15 comprises the same elements as claim 1, except that claim 15 is written in step-plus-function form. In view of the foregoing, Applicant requests allowance of claim 15, and also of claim 16, which depends from claim 15.

As to claim 17, Applicant reasserts all of the above arguments. The Examiner's rejection of claim 17 reduces to whether Krishnamurthy teaches the formation of an irregular mesh. Although Krishnamurthy discloses dividing an input surface into patches (Krishnamurthy, col. 2 lines 38-42), there is no suggestion in Krishnamurthy for forming an irregular mesh. The Examiner cites to Krishnamurthy at col. 2 lines 63-67 and col. 3 lines 1-52, but there is no suggestion or teaching in those sections (or anywhere else in the disclosure) pertaining to forming an irregular mesh. To the contrary, Krishnamurthy teaches fitting a *smooth surface* to the base mesh patch. Krishnamurthy, col. 2 lines 63-64; col. 3 line 5; col. 3 line 26. This smooth surface representation is merely "an approximation to the polygonal mesh," and is *not* an irregular mesh. Krishnamurthy, col. 3 lines 47-48. Applicant therefore requests that the Examiner withdraw the rejection of claim 17, and further, that the rejections of claim 18-21, each of which depend from claim 17, also be withdrawn.

Claims 8 and 22-42 stand rejected under §103(a) as being unpatentable over Loop in view of Krishnamurthy and in further view of Assa et al. (U.S. Patent No. 6,313,837). As to claim 8, which depends from claim 1, Applicant reasserts the above arguments pertaining to claim 1 and requests that claim 8 be allowed.

As to claim 22, the Examiner cites to Assa et al. for teachings related to data structures for polygonal meshes, and to Loop for its teachings related to using cursors, or "pointers," as a user input means for editing graphical images on a display monitor. In this case, the teachings of Loop regarding "pointers" are irrelevant to claim 22, because the "pointers" in claim 22 are entirely different than the "pointers" described in Loop. In computer technology, the term "pointer" has two main definitions: (1) a small arrow or other symbol on a display screen that moves as a user moves a mouse, and (2) a variable that contains the address of a location in memory. *See* Webopedia online computer dictionary, *available at* http://www.webopedia.com/.

Loop discloses a "cursor" as an input means enabling a user to edit graphics displayed on a computer monitor. Loop, col. 8 lines 9-16. The Examiner uses the term "pointer" to mean "cursor."

In contrast, throughout the present invention, and particularly in claim 22, the term "pointer" describes a variable that points to an address of a memory location. This is illustrated, for example, in the discussion of Fig. 19, which makes reference to "pointers" in the context of data structures, memory blocks, and memory usage. See Application at p. 22 line 26 through p.23 line 17; and Fig. 19. Thus, the term "pointer" as used in the present application is not a "cursor," and the teachings of Loop pertaining to cursors are irrelevant to the subject matter of pointers in claim 22. Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 22. Applicant further requests that the rejections of claims 23-31, which depend from claim 22, also be withdrawn in view of the above arguments.

As to claim 32-42, the Examiner incorporates the rationale used for rejecting claim 22 regarding "pointers." In view of the irrelevance of the "pointers" disclosed in Loop to the present application, Applicant contends that the "pointers" of claims 32-36 are neither taught nor anticipated by Assa et al. in view of Loop. Applicant therefore requests that the Examiner also allow claims 32-42.

Claims 9-10 stand rejected under §103(a) as being unpatentable over Loop in view of Krishnamurthy and in further view of Gueziec et al. (U.S. Patent No. 6,184,897). The Examiner cites to Gueziec et al. for its teachings related to cutting holes in a mesh by removing polygons. Implicit in the Examiner's rejections of claims 9-10 is an incorporation of the Examiner's rejection of claim 1, which is the independent claim from which claims 9-10 depend. In view of Applicant's previous discussion soliciting withdrawal of the rejections of claim 1, Applicant requests that the Examiner also withdraw the rejections of claims 9-10.

In view of all of the above, Applicant respectfully submits that all claims are allowable. Applicant therefore requests that the Examiner allow all claims and pass this application to issuance.

Applicant believes that no fees are due in connection with this Response. If any additional fees are in fact due, the Commissioner is hereby authorized to charge Howrey Deposit Account No. 08-3038 for the same referencing Howrey Dkt. No. 01339.0008.NPUS00.

Respectfully submitted,

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Sean D. Burdick

Sean D. Burdick, Reg. No. 51,513

HOWREY SIMON ARNOLD & WHITE, LLP
301 Ravenswood Avenue
Box No. 34
Menlo Park, CA 94025
Fax No. (650) 463-8400
Telephone No. (949) 759-5219